

Memorandum

To: Xavier Fernandez

SF Bay Regional Water Quality Control Board

From: Leslie Lazarotti, WRA

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Date: June10, 2015

Subject: Response to Incomplete Application for Water Quality Certification for Treasure Island/Yerba Buena Island Redevelopment Project, San Francisco County (CIWQS Reg. Meas.

398939, Place ID 810882)

WRA has prepared this memorandum on behalf of the Treasure Island Development Authority (TIDA) and the Treasure Island Community Development (TICD) in response to the subject notice of incomplete (NOI) application for Water Quality Certification (WQC) for Treasure Island/Yerba Buena Island Redevelopment Project (Project), located in San Francisco County, California.

In addition to the information provided in response to the notice of incomplete application, important changes to the project description are also communicated in this memorandum. A summary of updates to the Project Description is provided below, followed by a response to specific concerns raised by the Regional Water Quality Control Board (RWQCB). Attachment A to this memorandum provides a complete description of the revised project activities within waters of the State.

Summary of Changes to Project Description

Updates to the Project Description are detailed <u>in Attachment A to this memorandum.</u> The updated Project Description amends the previously submitted water quality certification permit application. In summary:

- Project activities no longer include dredging to create a navigable basin for the proposed ferry terminal. Therefore, the Project activities no longer include dredging up to 6,000 cubic yards to a depth of about -14 feet (plus 2 feet of over-depth allowance, totaling to -16 feet) to construct the ferry basin.
- Project stormwater outfalls have been redesigned to constitute an in-kind replacement of existing outfalls.
- One existing stormwater outfall will be relocated and replaced in-kind. The remainder of stormwater outfalls will be replaced in-kind in the same location.
- The dimensions of the ferry facility have been refined.
- The Project also now includes the removal of an existing 0.27 acre creosote pile supported pier structure on the west side of Treasure Island as mitigation for Project-related navigational fill.

Additionally, since the original permit submittal, a jurisdictional delineation has been completed for

the Project Area and the Biological Assessment and Essential Fish Habitat Assessment (Hanson Environmental, Inc. and Mosaic Associates, 2014), have been updated and redlined to reflect the changes in the Project activities are summarized in Table 1, below, and described in Attachment A. New figures provided in Attachment A replace figures in the original permit application. All other figures referenced that are not included in Attachment A can be found in the original permit application.

Based on these changes to the Project Description, TIDA and TICD have proposed Project eligibility under the following U.S. Army Corps of Engineers (Corps) authorizations:

- Outfalls: Nationwide Permit #3 (Maintenance) and Nationwide Permit #7 (Outfall Structures and Associated Intake Structures)
- Ferry Terminal and Associated Mitigation: Section 10 Letter of Permission

These two classes of project activities occurring in waters of the State are not interdependent, and so may be considered separate single and complete projects for the purpose of Corps regulatory permitting actions.

Table 1. Summary of Project Activities*				
Project Component	Solid Bay Fill at MHW (SF [ac])	Bay Fill (Horiz. Projection below MHW) (SF [ac])	Total Structure Volume (CY)	Below MHW Volume (CY)
Outfalls	T: 2,400 (0.06)	T: 11,900 (0.27)	T: 4,500	T: 3,400
	P: 0	P: 0	P: 0	P: 0
Ferry Facility	T: 0	T: 0	T:0	T: 0
	P: 2,875 (0.07)	P: 6,475 (0.15)	P: 6,190	P: 2,155
TOTAL	T: 2,400	T: 11,900	T: 4,500	T: 3,400
	P: 2,875 (0.07)	P: 6,475 (0.15)	P: 6,190	P: 2,155

^{*}T = Temporary, P = Permanent

Response to Notice of Incomplete Application

Mitigation for Impacts. The RWQCB requested information on compensatory mitigation.

The Project no longer includes dredging activities for the proposed ferry terminal landing and therefore no compensatory mitigation will be necessary for this activity. Project Impacts are now limited to those summarized above and detailed in Attachment A. Mitigation for Project-related impacts will be pursued through the removal of an existing pier structure on the west side of Treasure Island, resulting in the removal of approximately 0.27 acre of fill, as described in greater detail in Attachment A. The pier removal will occur concurrently with other activities affecting waters of the State. Pier removal will remove existing creosote piles, thus improving local water quality conditions and navigability of waters. Existing creosote piles will either be entirely removed or cut to two feet below the mudline (or as close as possible to this depth).

Climate Change Impacts. The RWQCB expressed concerns regarding a vulnerability assessment and climate adaptation strategy for the Project stormwater system.

The Applicant has prepared a vulnerability assessment that includes a climate change adaptation strategy, in accordance with the referenced California Ocean Protection Council Resolutions and the current State of California Sea-level Rise Guidance Document. The vulnerability assessment and climate change adaptation strategy is included in Attachment B.

Dredged Material Placement and Beneficial Reuse. The RWQCB requested further detail regarding the handling and disposal of dredged materials resulting from dredging previously proposed as part of the project.

Dredging is no longer proposed as part of the Project activities. Therefore, no dredged material placement or beneficial reuse is being considered for the Project.

Application Fee.

Given that the Project no longer includes dredging discharges, the application fee for water quality certification has been determined to be \$3,315 based on the attached dredge and fill fee calculator (v14c 03/23/2015) and the new impact acreages determined above. The application fee check for the full application fee will be sent to the RWQCB.

USACE Project Description.

Attachment A provides the revised Project Description for the Project, which is concurrently being submitted to the Corps. We are requesting a meeting with the Corps and RWQCB staff to ensure coordination between the two agencies with regard to the type of permit(s) being issued.

Noise Impacts.

The Applicant will keep the RWQCB informed of all correspondence with and determinations made by the USACE, the CDFW, and NMFS regarding noise impacts related to piling driving and other Project activities, and any required mitigation.

Please do not hesitate to contact with any further questions or concerns regarding the proposed Project.

ATTACHMENT A

REVISED PROJECT DESCRIPTIONS

STORM DRAIN OUTFALL RENOVATION AND CONSTRUCTION - UPDATED PROJECT DESCRIPTION

The Treasure Island/Yerba Buena Island Redevelopment Project requires replacement in place of up to thirteen (13) existing outfalls and relocation of one outfall located on Treasure Island and Yerba Buena Island. The replacement of these outfalls in place is eligible for, and meets all of the conditions for approval under Nationwide Permit #3. The outfall to be relocated is eligible for, and meets all of the conditions of approval under Nationwide Permit #7. The following provides additional information about the relocation and replacement of the storm water outfalls.

BOX 6. PROPOSED PROJECT STARTING DATE

Outfall construction may coincide with the rainy season (October – April) as it will take place between March 1 and November 30, consistent with Mitigation Measure M-B1-2b from the FEIR¹.

Major Phase 1: 2015-2025

Outfall work beginning no earlier than 2016 and completed no later than 2030.

Up to seven outfalls will be replaced or renovated, and thirteen will be abandoned in place on TI and YBI. This phase includes the relocation of one outfall.

Major Phase 2: 2020-2027

Outfall work beginning no earlier than 2020 and completed no later than 2030. Two outfalls will be replaced or renovated, and one will be abandoned in place on TI.

Major Phase 3: 2023-2030

Outfall work beginning no earlier than 2023 and completed no later than 2030.

One outfall will be replaced or renovated, and two will be abandoned in place on TI.

Major Phase 4: 2026-2034

Outfall work beginning no earlier than 2026 and completed no later than 2030. Four outfalls will be replaced or renovated, and three will be abandoned in place on TI.

BOX 7. DESCRIPTION OF THE PROPOSED PROJECT

1. INTRODUCTION

Treasure Island (TI) and Yerba Buena Island (YBI) are in San Francisco Bay, about halfway between the San Francisco mainland and Oakland (Figure 1 in the original permit application) The Islands are the site of the former Naval Station Treasure Island ("NSTI"), which is owned by the U.S.

¹ Mitigation Measure M-BI-2a: Restriction of Construction Activities stormwater outfall conducted in and around the Islands' rocky shoreline shall be generally restricted to the terrestrial and upper intertidal zones. Activities in the lower intertidal and near subtidal zone shall be minimized to the maximum extent practicable, using the smallest area and footprint for disturbance as possible. Movement and disturbance of existing rocks in the lower intertidal zone shall be prohibited.

Treasure Island/Yerba Buena Island Redevelopment Project Storm Drain Outfalls – Updated Project Description

Navy. NSTI was closed on September 30, 1997, as part of the Base Realignment and Closure Program. The Islands also include a U.S. Coast Guard Station and Sector Facility, a U.S. Department of Labor Job Corps campus, and Federal Highway Administration ("FHWA") land occupied by the San Francisco-Oakland Bay Bridge ("Bay Bridge") and tunnel structures.

The Treasure Island Development Authority ("TIDA") is proposing to redevelop the portions of NSTI still owned by the Navy. The Development Plan will be carried out by Treasure Island Community Development, LLC ("TICD").

Currently, the former military base consists primarily of low-density residential uses, along with vacant and underutilized non-residential structures, existing and former non-residential uses, parking and roadways, open space, a wastewater treatment facility, and other infrastructure. The Development Plan Area will be redeveloped with a new, high-density, mixed-use community with a variety of housing types, a retail core, open space and recreation opportunities, on-site infrastructure, and public and community facilities and services. In all, there will be up to 8,000 residential units, 450,000 square feet (sq. ft.) of new commercial and retail space; up to 500 hotel rooms and a cultural center; a new ferry terminal and transit program; approximately 300 acres of parks and open space; an approximately three-mile long shoreline trail on Treasure Island and Yerba Buena Island; and new and/or upgraded public services and utilities, including a new or upgraded wastewater treatment plant and a new recycled water plant.

Implementation of the Development Plan will be phased over a 10-15 year period. The TIDA is applying for a Nationwide Permit (NWP) 3 and NWP 7 from the U.S. Army Corps of Engineers (Corps) and a Water Quality Certification from the Regional Water Quality Control Board for the discharge of fill in waters of the U.S. associated with the renovation of the existing storm drain outfall system.

Project activities related to the proposed ferry terminal, including the installation of associated piers, gangways, floats, and breakwaters, are unrelated to outfall structure maintenance and are being pursued through a Corps' Letter of Permission. TIDA is currently in the process of applying for a major permit from the San Francisco Bay Conservation and Development Commission (BCDC) for those same activities as well as improvements to the shoreline revetment on TI and trails within BCDC jurisdiction on TI and YBI.

2. PROJECT DESCRIPTION

2.1 Overview

Treasure Island contains approximately 404 acres of land, and Yerba Buena Island (YBI), approximately 160 acres. The project will convert approximately 367 acres on TI and approximately 94 acres on YBI from a former military base to a dense, mixed-use development.

The redevelopment of TI and YBI includes: up to 8,000 residential units; 450,000 square feet of retail space; up to 500-hotel rooms and a cultural center; a new ferry terminal and transit program; approximately 300 acres of new public parks and open space; an approximately 3 -mile-long public shoreline trail around TI and various trails on YBI. The project would redevelop both TI and YBI over four phases spanning 10 to 15 years (Figure 2 in the original permit application). Open space management on YBI will be implemented consistent with the Treasure Island Habitat Management Plan (HMP).

There are five primary components to the redevelopment of TI and YBI, including: (1) residential; (2)

Treasure Island/Yerba Buena Island Redevelopment Project Storm Drain Outfalls – Updated Project Description

open space and recreation; (3) transportation; (4) commercial and adaptive reuse; and (5) community and public facilities. Figure 2 in the original permit application depicts the locations of these redevelopment components and their location relative to each major phase of development.

2.2 Project Components in Waters of U.S.

Project components requiring the discharge of fill material into waters of the U.S. include improvements to existing drainage structures and outfalls and the relocation of one outfall structure. A description of Project elements are provided below. Construction methods, materials, equipment, timeline, Project phase in which construction will occur and impacts on open water and shoreline habitat, as well as fish and wildlife are described. A phasing schedule for construction is provided in Figure 3 in the original permit application.

The residential, open space, commercial, community, and public facilities elements of the Project do not entail any work in waters of the U.S.

2.2.1 Outfall Improvements and Stormwater Management

Stormwater runoff from streets and paved areas on TI and YBI is currently discharged untreated directly to the Bay through 31 outfalls around the perimeter of TI and 32 outfalls from YBI. The existing stormwater system will be replaced with a new collection system, which will include gravity pipelines, force mains, lift stations, pump stations and the reconstruction of existing outfalls. Predischarge treatment will be provided by street planters and bioretention treatment planters. The stormwater management plan will be designed and constructed consistent with San Francisco Public Utility Commission (SFPUC) standards and regulations. Existing outfalls will be replaced, relocated, renovated, or abandoned in place during each of the four phases of construction (see Figures 8 and 9 in this attachment, which replace Figures 8 and 9 in the original application). A total of 14 outfalls will be replaced, or renovated from existing outfalls on TI and YBI, with one of those outfalls being relocated. The disturbance area surrounding each outfall will be isolated and dewatered with the installation of a coffer dam prior to earthwork. Each outfall will be constructed by temporarily excavating an approximately 850 sq. ft. area and removing approximately 50 CY of existing rock slope protection to allow installation of a precast or cast-in-place concrete headwall. After the outfall has been replaced, the work area will be backfilled with the previously excavated rock riprap to conform to the existing slope. This construction method results in only temporary impacts with no net change in fill in the Bay. Replaced riprap will be supplemented with new rock riprap, which will be placed outside of jurisdictional waters. Figure 9 in this attachment shows the typical cross section for outfall construction.

Existing rock shoreline protection at the outfalls to be replaced or renovated will be excavated with the use of an excavator positioned on the shoreward side of the revetment. Excavated materials will be stockpiled in adjacent uplands for re-use or offsite disposal. The work areas surrounding the outfalls will be dewatered prior to construction with the use of sandbags, steel sheetpiles or water filled bladder-type cofferdams. The exact type of cofferdam would be determined by the contractor's means and methods as to which is most constructible given the thick rock embankment and slope. Water would be removed with pumps on site returning the water to the bay.

Treasure Island/Yerba Buena Island Redevelopment Project Storm Drain Outfalls – Updated Project Description

Box 7. Purpose of the Proposed Project:

The TIDA, a single-purpose public agency responsible for the development, and the TICD, a private entity competitively selected as the master developer, are joint sponsors of the Project. The Project's overall purpose is to convert approximately 367 acres on Treasure Island and approximately 94 acres on Yerba Buena Island from a former military base to a dense, mixed-use development with residential, commercial, cultural, hotel, recreational, and retail uses centered around an intermodal Transit Hub. Supporting infrastructure, public services and utilities, and a substantial amount of open space would also be provided.

Box 7. Environmental Documents (non-CEQA)

Applied Marine Sciences, Inc., (AMS) Survey of Intertidal Habitat and Marine Biota at Treasure Island and Along the Western Shoreline of Yerba Buena Island. Report prepared for the Treasure Island Redevelopment Project, San Francisco, CA. April 2009.

Conger Moss Guillard, ESA and Wood Biological Consulting. *Yerba Buena Habitat Management Plan*. March 2011.

Merkel & Associates. *Eelgrass Habitat Surveys for the Emeryville Flats and Clipper Cove, Yerba Buena Island*. October 1999-2005, and 2007. Prepared for the California Department of Transportation. January 2008.

BOX 8B WATERWAY IMPACTS: PLACEMENT OF STRUCTURES AND/OR FILL IN WATERS OF THE STATE

Table 1. Treasure Island Storm Drain Outfalls Bay Fill					
Project	Solid Bay Fill at	Bay Fill (Horiz.	Volume (CY)		
Component	MHW (SF [ac])	Projection below MHW) (SF [ac])	Total Structure	Below MHW	
Outfalls temporary (coffer dams, 14 total)	2,400 (0.06)	11,900 (0.27)	4,500	3,400	
Outfalls permanent	0	0	0	0	

FERRY FACILITY CONSTUCTION – UPDATED PROJECT DESCRIPTION

The Treasure Island/Yerba Buena Island Redevelopment Project requires placement of fill in navigable waters of the U.S. to support safe navigation and berthing for ferry service located on Treasure Island. The Project also involves the removal of a pile-supported pier structure as mitigation for impacts resulting from the ferry construction. The placement of fill to support navigation and safe berthing, as well as the associated mitigation, is eligible for approval by a Letter of Permission pursuant to Section 10 of the Rivers and Harbors Act. The following provides additional information about Project.

BOX 6. PROPOSED PROJECT STARTING DATE

Construction of the ferry facilities may commence as early as 2017 and not later than 2020. The exact year of this construction is dependent upon the date of construction of the first homes. Ferry facilities construction including pier/gangway installation and installation of the float may coincide with the rainy season (October – April) as work will be conducted work windows established by the USACE Long Term Management Strategy ("LTMS")².

Major Phase 1: 2015-2025

Ferry Facilities beginning between 2018 and 2020 and lasting two work window seasons, completed between 2019 and 2021.

Major Phase 2: 2020-2027

Construction of the South Breakwater of Ferry Facilities to begin in approx. 2023 and to be completed no later than 2030.

BOX 7. DESCRIPTION OF THE PROPOSED PROJECT

2. Introduction

Treasure Island (TI) and Yerba Buena Island (YBI) are in San Francisco Bay, about halfway between the San Francisco mainland and Oakland (Figure 1 in the original permit application) The Islands are the site of the former Naval Station Treasure Island ("NSTI"), which is owned by the U.S. Navy. NSTI was closed on September 30, 1997, as part of the Base Realignment and Closure Program. The Islands also include a U.S. Coast Guard Station and Sector Facility, a U.S. Department of Labor Job Corps campus, and Federal Highway Administration ("FHWA") land occupied by the San Francisco-Oakland Bay Bridge ("Bay Bridge") and tunnel structures.

The Treasure Island Development Authority ("TIDA") is proposing to redevelop the portions of NSTI still owned by the Navy. The Development Plan will be carried out by Treasure Island Community Development, LLC ("TICD").

Currently, the former military base consists primarily of low-density residential uses, along with vacant and underutilized non-residential structures, existing and former non-residential uses, parking and roadways, open space, a wastewater treatment facility, and other infrastructure. The

² U.S. Army Corps of Engineers, LTMS Environmental Work Windows Informal Consultation Preparation Packet, February 2004

Treasure Island/Yerba Buena Island Redevelopment Project Ferry Facility – Updated Project Description

Development Plan Area will be redeveloped with a new, high-density, mixed-use community with a variety of housing types, a retail core, open space and recreation opportunities, on-site infrastructure, and public and community facilities and services. In all, there will be up to 8,000 residential units, 450,000 square feet (sq. ft.) of new commercial and retail space; up to 500 hotel rooms and a cultural center; a new ferry terminal and transit program; approximately 300 acres of parks and open space; an approximately three-mile long shoreline trail on Treasure Island and Yerba Buena Island; and new and/or upgraded public services and utilities, including a new or upgraded wastewater treatment plant and a new recycled water plant.

Implementation of the Development Plan will be phased over a 10-15 year period. The TIDA is applying for an Letter of Permission (LOP) from the Army Corps of Engineers and a Water Quality Certification from the Regional Water Quality Control Board for the discharge of fill in waters of the U.S. associated with construction of the ferry terminal and renovation of the existing storm drain outfall system. TIDA will also apply for a major permit from the San Francisco Bay Conservation and Development Commission (BCDC) for those same activities as well as improvements to the shoreline revetment on TI and trails within BCDC jurisdiction on TI and YBI.

2. PROJECT DESCRIPTION

2.3 Overview

Treasure Island contains approximately 404 acres of land, and Yerba Buena Island (YBI), approximately 160 acres. The project will convert approximately 367 acres on TI and approximately 94 acres on YBI from a former military base to a dense, mixed-use development. The redevelopment of TI and YBI includes: up to 8,000 residential units; 450,000 square feet of retail space; up to 500-hotel rooms and a cultural center; a new ferry terminal and transit program; approximately 300 acres of new public parks and open space; an approximately 3 -mile-long public shoreline trail around TI and various trails on YBI. The project would redevelop both TI and YBI over four phases spanning 10 to 15 years (Figure 2 in the original permit application). Open space management on YBI will be implemented consistent with the Treasure Island Habitat Management Plan (HMP).

There are five primary components to the redevelopment of TI and YBI, including: (1) residential; (2) open space and recreation; (3) transportation; (4) commercial and adaptive reuse; and (5) community and public facilities. Figure 2 in the original permit application depicts the locations of these redevelopment components and their location relative to each major phase of development.

Redevelopment of TI and YBI will require earthwork, geotechnical stabilization of TI and the causeway connecting it to YBI, the importation of fill material to raise the upland surface elevation of TI to address flood protection and potential sea level rise, selective removal of trees and vegetation, demolition of buildings and other structures, and construction of new structures and infrastructure during the four phases of the project.

2.4 Project Components in Waters of U.S.

Project components requiring the discharge of fill material into waters of the U.S. include construction and operation of a new ferry terminal. A description of Project elements is provided below. Construction methods, materials, equipment, timeline, Project phase in which construction will occur and impacts on open water and shoreline habitat, as well as fish and wildlife are described. A phasing schedule for construction is provided in Figure 3 in the original permit application.

Treasure Island/Yerba Buena Island Redevelopment Project Ferry Facility – Updated Project Description

The residential, open space, commercial, community, and public facilities elements of the Project do not entail any work in waters of the U.S.

2.2.1 Ferry Terminal

Located at the southwest corner of TI, a new ferry quay and terminal will be constructed to provide service to downtown San Francisco. Once a ferry operator has been selected and the terminal has been constructed, the ferry service will be operated, with initial runs at approximately 60-minute intervals. The goal will be to provide service to downtown San Francisco at 15-minute intervals at peak periods from 5am to 9pm at full build-out of the Project.

The ferry terminal will include two side-loading ferry slips (where ferry boat loads passengers) that will have capacity to accommodate demand increases in the future. The land access to the ferry slip includes an access pier, an ADA- compliant gangway, a steel or concrete float that would be anchored by six guide piles and mooring dolphins to protect the ferry from bumping against the float and other structures. The float will have mooring fittings and access platforms on each side to allow two ferries to moor at the float at the same time, providing two slips.

To protect the ferry slips and allow ferry service to continue in the exposed wave climate of SF Bay, the Project includes an approximately 200- to 300- foot-wide west-facing basin with angled breakwaters.

The ferries themselves will be able to hold approximately 149 to 399 passengers, and will be approximately 140 feet long and 55 feet wide with a draft of up to eight feet. Up to two vessels could overnight at the ferry terminal, and routine operations, such as sewage pump-out, filling potable water storage containers, and light maintenance will occur at the terminal.

Construction of the ferry quay and terminal entail construction of the following elements in waters of the U.S.:

- Breakwaters
- Rock slope linkage of shoreline to the breakwater
- Pier with foundation piles, gangway and float (including guide and fender piles)

The Project includes approximately 0.15 acre (6,460 square feet) of fill for the ferry terminal facilities, and a pile-supported, 5,200 square foot floating dock. Table 1 in Box 8B text summarizes bay fill associated with the ferry terminal. Figure 4 in this attachment provides an overview of the ferry terminal facilities.

<u>Breakwaters</u>: Two breakwaters made of precast 14-inch thick concrete sheet piles will be constructed to create the west-facing basin. An approximately 760-foot-long breakwater to the north, and an approximately 350-foot-long breakwater to the south will be constructed. The concrete sheet pile breakwater will terminate on the east side (shore) at the toe of the slope of the existing rock revetment on TI that will leave a gap between the sheets and the existing rock slope. This gap will be closed with a rock slope placed on top of the existing rock slope and perpendicular to it. Both breakwaters will have navigation lights to mark the harbor entrance, but will otherwise not be lighted. Due to high waves overtopping the breakwaters, no public access along the breakwaters is proposed.

The breakwaters will be installed with an impact hammer with approximately 100,000 ft-lb energy output operated from barge-mounted cranes. Concrete batter piles (24-inch octagonal at 15-foot centers) will be installed along the basin-interior side of the breakwaters. Up to 60 concrete batter piles will support the north breakwater, and up to 30 batter piles will support the south breakwater (Figure 5 in the original permit application).

The north breakwater will be installed between June and November (in water work window) as the first in-water element of ferry terminal construction. The exact year of this construction is dependent upon the date of construction of the first homes and it is estimated that it will be no earlier than 2018 nor later than 2020. The duration of the in water portion of the breakwater work in the first year of construction is estimated to be 3-5 months to drive the batter piles and concrete sheets and to place the rock closure slope at the shore, described in the following section. No dewatering will be required for this work nor will any excavation to place the breakwaters be required. Since the existing shore line is fully protected from wave exposure, no slope protection will be needed during construction. The south breakwater may be installed in a second phase or in the same year. Alternatively, the underwater cable may be relocated and the south breakwater constructed as shown in Figure 4 in this attachment.

During construction of the breakwaters best management practices will include no fueling of equipment allowed on site for over water work, use of equipment that minimizes turbidity in the water, and require protective netting or equivalent devised to ensure no debris can fall into the water during the work. Avoidance and minimization measures are further described in section 4.2 of the Project *Biological Assessment* and *Essential Fish Habitat Assessment* (Mosaic 2014; Attachment B)

Rock Slope Closure (Linkage between Breakwater and Shoreline): Two rock slope connections will be constructed on each side of the ferry terminal at the shore end of the breakwaters (Figure 5 in original permit application).

The rock closure will consist of rip rap rock similar to the size (1-2 ton rock) and graduation of the existing rock slope and will be placed on top of the existing rock. The rock slope closures are needed to anchor and provide continuous wave protection of the breakwaters' connections at the shoreline. Each rock slope will be approximately 600 SF (0.014 ac) in size as measured at MHW, or 2,400 SF (0.06 ac) at bay bottom (each rock slope). The rock will be constructed following construction of each breakwater with the use of an excavator positioned on the landward side of the shoreline revetment, as well as with the use of an excavator operated from a barge. No dewatering will be performed for this work. This work will be performed during the first year of construction to support and protect the concrete sheets.

Pier (Abutment), Gangway and Float: The land access to the ferry slip includes:

- Pier: 13-feet-wide, 145-foot-long, with railing that may also have a canopy;
- Gangway: approximately 13-feet-wide, 90-feet-long, ADA- compliant, connects the pier and float;
- Float: approximately 45-feet-wide, 115-feet-long, steel or concrete, anchored by six guide and fender piles. Mooring dolphins and/or fender walls will be included to protect the ferry from bumping against the float and other structures.

These features are shown in Figure 6 in the original permit application. The float will have mooring fittings and access platforms on each side to allow two ferries to moor at the float at the same time.

The pier will be supported by two 48- to 60-inch steel pier foundation piles that will be installed with the use of a vibratory hammer with an energy output of 6,000 ft-lb and a variable frequency between zero to 1,400 vibrations per minute operated from a barge-mounted crane to a depth of embedment of 16 to 190 feet below the bay bottom. Four 42-inch diameter steel fender and guide piles will be installed on the west side of the float, and two 42-inch diameter steel guide piles will be installed on the east side of the float. The steel piles will be installed with the use of a vibratory hammer with an energy output of 6,000 ft-lb and a variable frequency between 0 to 1,400 vibrations per minute operated from a barge -mounted crane. The piles will be installed to a depth of embedment of 50-90 feet below the bay bottom, estimated, to be confirmed by geotechnical investigations currently in progress.

The installation of the pier, gangway, and float for the ferry slip will occur in the second year of the construction of the ferry terminal. This work will occur during the same in water work window from June to November. The pier deck will be installed atop the piles described above either formed of in-place or precast concrete. The work would be performed from barge-mounted cranes or from scaffolding clamped to the installed piles. The float will be fabricated offsite and transported to the site with the use of a tug or similar tow vessel. The gangway would be fabricated off site and brought to the site on a barge. The gangway would then be placed on the pier and float by a barge mounted crane. The concrete sheet piles, batter, guide, fender and pier foundation piles will be manufactured off site and transported to the site on a barge that will stage delivery of materials within and just west of the ferry terminal location. Upon completion of this work, the ferry slip will be operational.

Box 7. Purpose of the Proposed Project:

The TIDA, a single-purpose public agency responsible for the development, and the Treasure Island Community Development LLC (TICD), a private entity competitively selected as the master developer, are joint sponsors of the Project. The Project's overall purpose is to convert approximately 367 acres on Treasure Island and approximately 94 acres on Yerba Buena Island from a former military base to a dense, mixed-use development with residential, commercial, cultural, hotel, recreational, and retail uses centered around an intermodal Transit Hub. Supporting infrastructure, public services and utilities, and a substantial amount of open space would also be provided.

Box 7. Environmental Documents (non-CEQA)

Applied Marine Science, *Benthic Survey of Proposed Treasure Island, California Redevelopment Ferry Terminal Location*. Report prepared for the Treasure Island Redevelopment Project, San Francisco, CA. May 2009.

Applied Marine Sciences, Inc., (AMS) Survey of Intertidal Habitat and Marine Biota at Treasure Island and Along the Western Shoreline of Yerba Buena Island. Report prepared for the Treasure Island Redevelopment Project, San Francisco, CA. April 2009.

Conger Moss Guillard, ESA and Wood Biological Consulting. *Yerba Buena Habitat Management Plan*. March 2011.

Hanson Environmental, Inc. and Mosaic Associates. *Biological Assessment and Essential Fish Habitat Assessment for Construction and Long-term Operations and Maintenance of a Ferry Terminal and Stormwater Discharges Located on Treasure Island*. November 2014.

Treasure Island/Yerba Buena Island Redevelopment Project Ferry Facility – Updated Project Description

Merkel & Associates. *Eelgrass Habitat Surveys for the Emeryville Flats and Clipper Cove, Yerba Buena Island*. October 1999-2005, and 2007. Prepared for the California Department of Transportation. January 2008.

BOX 8B WATERWAY IMPACTS: PLACEMENT OF STRUCTURES AND/OR FILL IN WATERS OF THE STATE

Table 1: Treasure Island Ferry Terminal Bay Fill					
Ferry Component	Bay Fill at MHW (SF [ac])	Bay Bottom Footprint (Horiz.	Volume (CY)		
reny component	Solid	Projection below MHW) (SF [ac])	Total Structure	Below MHW	
Breakwaters & Batter Piles	1,550 (0.04)	1,550 (0.04)	3,350	1,250	
Rock Slopes	1,200 (0.03)	4,800 (0.12)	950	840	
Pier & Foundation Piles	25 (0.00)	25 (0.00)	410	15	
Gangway			90		
Float & Guide and Fender Piles	100 (0.00)	100 (0.00)	1,390	50	
Total Ferry Component	2,875 (0.07)	6,475 (0.15)	6,190	2,155	

Note: Some apparent errors due to rounding.

Table 2.	Table 2. Treasure Island/Yerba Buena Island Redevelopment Fill in water of the U.S. and waters of the State			
Map location number*	Project Component	Reason for Action & Component Type	Amount and Type of Material (CY)	Surface Area Affected (acres, linear feet), Temporary (T) or Permanent (P)
1	Breakwater Sheets	Protect ferry slips & allow safe navigation and berthing for ferry service (Structural)	Concrete sheets 14" thick and cap 790 CY N. Breakwater 225 CY S. Breakwater	N. Breakwater: 0.02 ac P S. Breakwater: 0.009 ac P
2	Breakwater Batter Piles	Support breakwaters (Structural)	Concrete piles, 24" octagonal at 15' centers 200 CY N. Breakwater 35 CY S. Breakwater	N. Breakwater: 0.004 ac P S. Breakwater: 0.002 ac P
3	Float Guide and Fender Piles	Anchor float & protect ferry from bumping into float to allow for safe berthing and navigation (Structural)	Steel guide piles, 42" diameter 15 CY	Guide & fender piles: 0.001 ac P
4	Float	Loading platform for passengers (Floating)	Steel or concrete float	0.12 ac P
5	Pier Piles	Support pier for access to ferry boarding (Structural)	Concrete pier foundation piles, 48" diameter 15 CY	0.001 ac P
6	Rock Slopes	Protect connection of breakwater to shoreline (Non-structural)	Rock riprap 420 CY N. Breakwater 420 CY S. Breakwater	N. Breakwater: 0.06 ac P S. Breakwater: 0.06 ac P

^{*}Map location numbers are shown on Figure 4, below.

BOX 12. Mitigation

To offset impacts of the Project, the applicant proposes to remove an existing pile-supported pier structure (Pier 23) on the west side of Treasure Island, as shown in Figures 10 and 11 of this attachment.

The existing pier consists of an 11,684-square-foot pier deck (254 feet long by 46 feet wide) and a 330-square-foot wooden gangway (55 feet long by 6 feet wide) that connects the pier to the shore. The pier deck is located entirely within jurisdictional waters. Approximately 258 square feet of the 330-square-foot wooden gangway are located within jurisdictional waters. The pier is constructed with timber treated with creosote preservative. Piles supporting the pier are on a 10-foot by 12-foot spacing with batter (slanted) piles along three of the west facing bents (pile rows) to withstand the predominant wave forces. There are five vertical piles, three batter piles, and one fender pile in each bent. There are 22 bents and 198 timber piles.

Treasure Island/Yerba Buena Island Redevelopment Project Ferry Facility – Updated Project Description

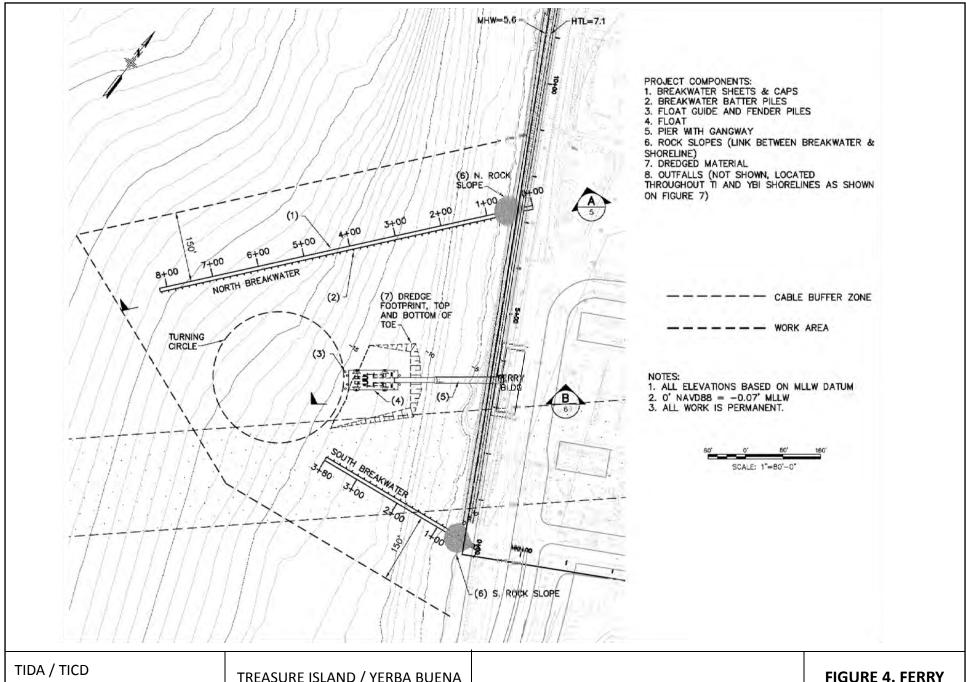


Pier 23 - Existing Condition (Photograph taken 2015)

Pier removal will involve the removal of 0.27 acre (11,942 square feet) of pile-supported pier and gangway structures in jurisdictional waters, consisting of:

- 11,684 square feet of pier deck (254 feet long by 46 feet wide);
- 258 square feet of gangway deck (43 feet long by 6 feet wide); and
- 115 cubic yards of piles if cut below the mudline, or 265 cubic yards of piles if removed entirely.

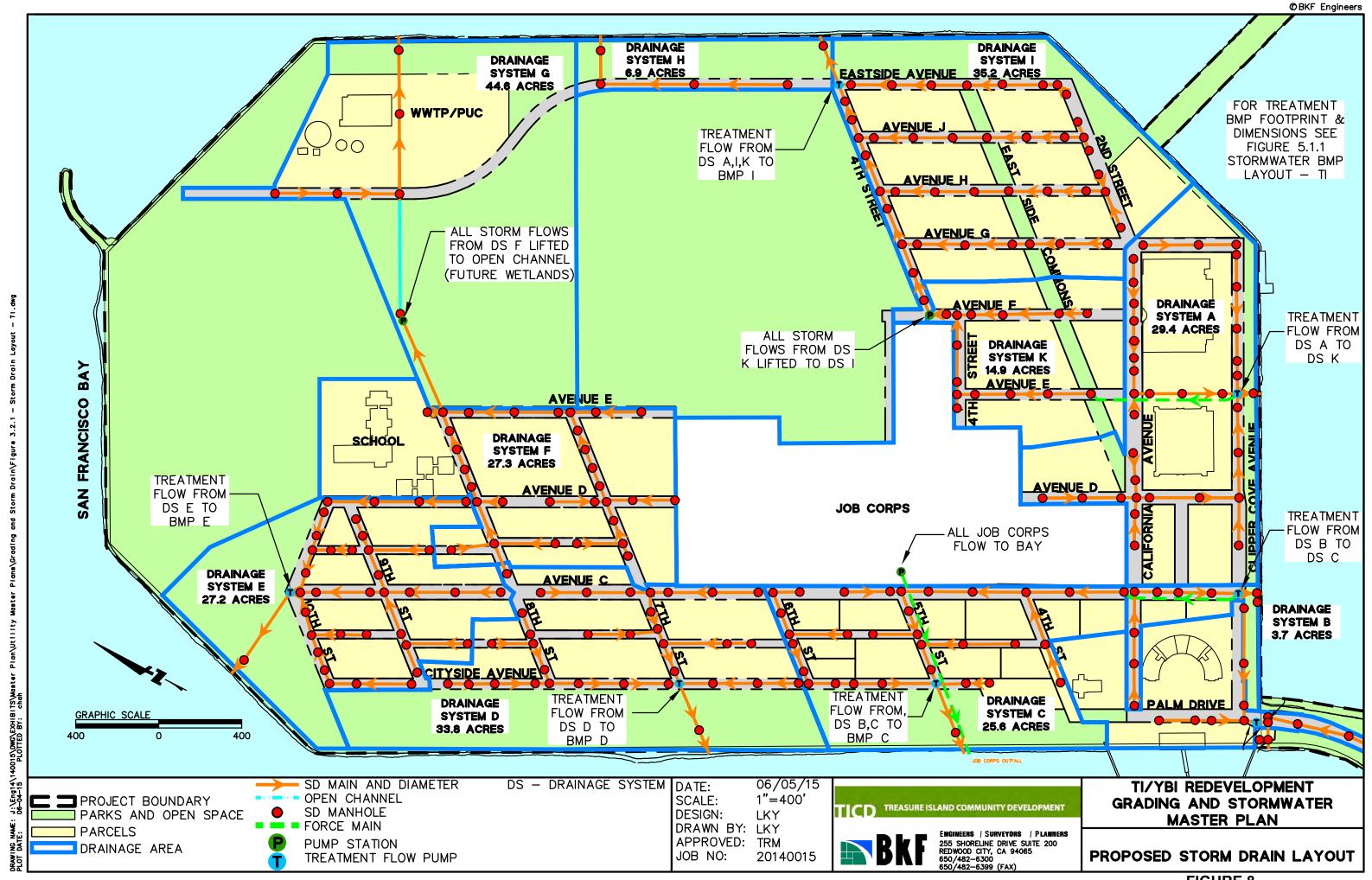
Pier removal activities will occur concurrently with other Project activities affecting waters of the U.S. and state. Pier removal will involve removing the deck and existing creosote-treated piles, thus improving local water quality conditions and navigability of waters. Existing piles will either be entirely removed or cut to two feet below the mudline (or as close as possible to this depth).



TIDA / TICD
ONE SANSOME ST. SUITE 3200
SAN FRANCSICO, CA 94014

TREASURE ISLAND / YERBA BUENA REDEVELOPMENT PROJECT

FIGURE 4. FERRY DOCK SITE PLAN

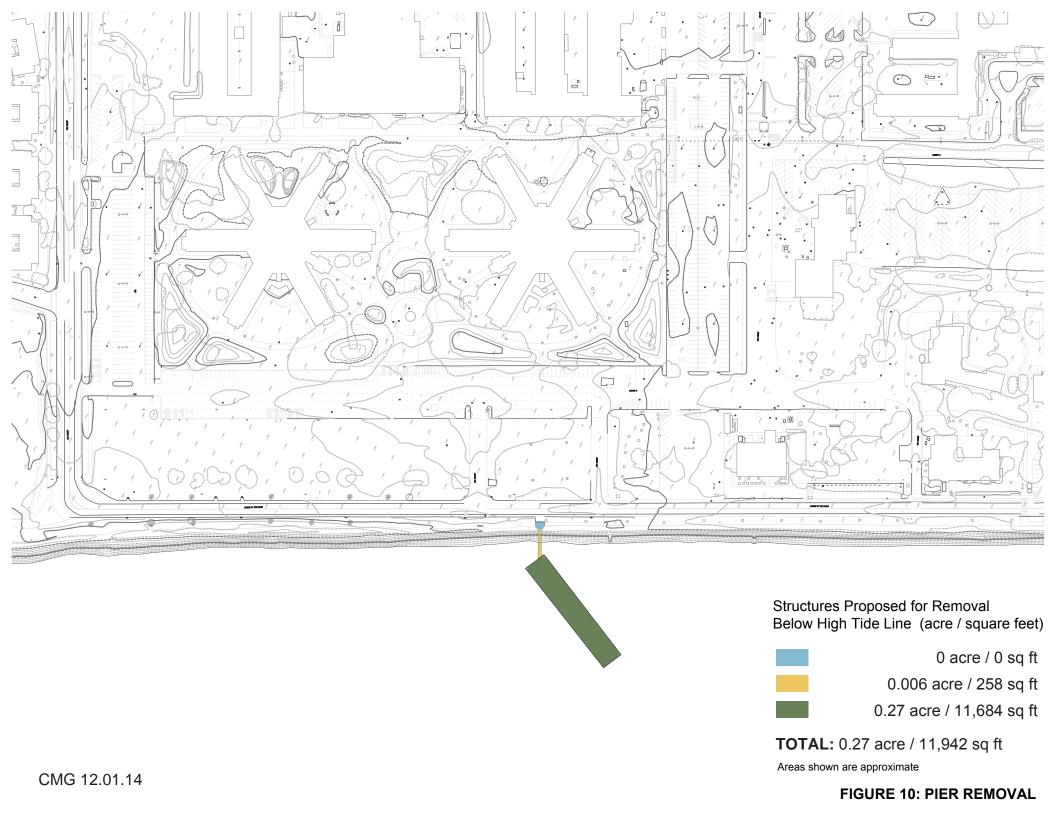


PARKS

50% SCHEMATIC DESIGN

PLAN AND SECTIONS 1 OF 6

CALE AS NOTED C-1



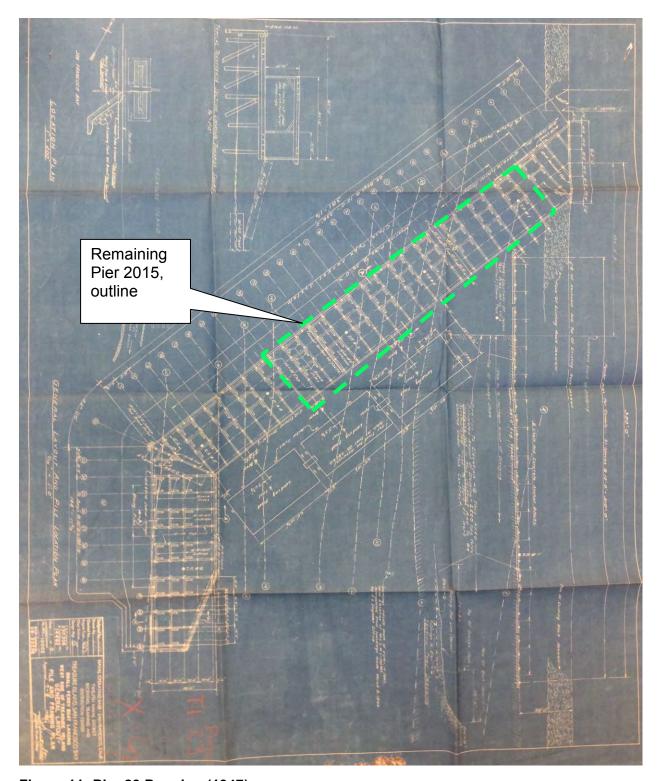


Figure 11- Pier 23 Drawing (1947)

ATTACHMENT B

Sea Level Rise Risk Assessment and Adaptive Management Plan

Treasure Island Development Project

Sea Level Rise Risk Assessment and Adaptive Management Plan



Prepared for: Treasure Island Community Development

One Sansome Street, Suite 3200 San Francisco, CA 94104

Prepared By:



2185 N. California Blvd, Suite 500 Walnut Creek, CA 94596

> March 2015 M&N Job No: 8548 DRAFT

Treasure Island Development Project

Sea Level Rise Risk Assessment and Adaptive Management Plan

Prepared for:

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1. INTRODUCTION

1.1 BACKGROUND

This report is a coastal flooding and sea level rise risk assessment and adaptive management plan for the Treasure Island Development Project. The Treasure Island Development Authority (TIDA) and Treasure Island Community Development (TICD) are working together in a public-private partnership towards the redevelopment of Treasure Island (Project). The Project's environmental impact report was certified in 2011, and construction of the first phase is anticipated to start in 2015-2016.

The Project encompasses both Treasure Island and Yerba Buena Island, however Treasure Island is the focus of the sea level rise adaptation strategy because Yerba Buena Island's roadways and development parcels are elevated above the year 2100 water levels. Yerba Buena Island is a natural rock island and is significantly higher in elevation than Treasure Island, which was constructed using sand mined from San Francisco Bay in 1936 for the Golden Gate International Exposition.

Moffatt & Nichol (M&N) has supported the Treasure Island development design over the years and has produced numerous documents summarizing sea level rise projections, coastal flooding, and tsunami estimates. The document list includes:

- M&N, Coastal Flooding Analysis & Adapting to Sea Level Rise, October, 2014
- M&N, Treasure Island Ferry Terminal Coastal Engineering Assessment, Sept. 14, 2009
- M&N, Treasure Island Coastal Flooding Study, Apr. 2009

This report, "Sea Level Rise Assessment and Adaptive Management Plan", reiterates information in the above reports and provides additional details where necessary.

1.2 PURPOSE

This report is intended to assess coastal vulnerability to sea level rise to satisfy BCDC's requirement for a risk assessment based on the estimated 100-year flood elevation that takes into account the best estimates of future sea level rise in 2050 and 2100. This report also summarizes the adaptation management plan based on the risk assessment results.

1.3 CURRENT POLICIES

Potential solutions to incorporating sea level rise into the planning/design process for coastal developments may be defined by mandates or policy guidance on the part of those charged with the public interest, including FEMA (Federal Emergency Management Agency), the U.S. Army Corps of Engineers (USACE), Coastal Zone Management Agencies, or Regional entities that oversee the wellbeing of their respective coastlines and coastal communities.

At the federal level, the USACE and U.S. Environmental Protection Agency (EPA) have recognized that global warming and rising seas need to be considered within the design life of all federally funded projects. Prior to 2009, the standard of reference remained a 1987 National Research Council (NRC 1987) report that assumed three hypothetical sea level rise scenarios for the year 2100: ½ meter, 1 meter, and 1½ meters. In July 2009, the USACE adopted a multiple scenario approach where levels of risk corresponding to the three NRC scenarios would be evaluated for the no-project and proposed-project conditions, and a decision would be made in concert with the local sponsor. This process applies to federally



funded projects only and is not triggered for projects such as this Treasure Island Project, for which the only USACE involvement is a permit.

The National Flood Insurance Program administered by FEMA, which is the primary mechanism for communities receiving flood protection, does not include sea level rise in its flood mapping criteria for flood insurance. However, as a result of recent disasters, FEMA embarked upon a map modernization program, which involves updating flood insurance rate maps, many of which date from the 1970s and 1980s. Since sea levels have risen and levees have settled, many of the areas no longer meet CFR 65.10 requirements, which has resulted in the drafting of "preliminary" flood maps that show several communities in the flood plain, the implication being that some communities have lost "protected" status. This has already happened in many urban areas, including Sacramento and Redwood City in Northern California. FEMA has also updated its mapping approach for areas vulnerable to coastal flooding to a risk-based methodology. This involves re-evaluating present sea levels in the project area, estimating extreme high water elevations due to tides, surges, tsunamis etc., and coming up with local sea level trends. Then, using the new FEMA evaluation approach, coastal protection concepts need to be developed and designed such that the Special Flood Hazard Area designation of the project area can be removed.

In some coastal states, specific policies and mandates have been issued to address the effects of climate change, resulting in relevant state and local coastal zone management agencies considering sea level rise issues as they process development permits for projects. California requires all state-funded and state agency projects to incorporate the effects of sea level rise and climate change in project planning, and has recommended guidance to evaluate sea level rise. These include reports by the Coastal and Ocean Working Group of the California Climate Action Team (CO-CAT 2013) and the NRC (2012). The California Natural Resources Agency (CNRA 2009) has also authored an adaptation strategy, and now requires state agencies to demonstrate that new state-funded projects account for sea level rise.

On a regional level, the San Francisco Bay Conservation and Development Commission (BCDC) released the amended *San Francisco Bay Plan* in 2011, which requires sea level rise risk assessments be based on the best estimates of future sea level rise. BCDC's *New Sea Level Rise Policies Fact Sheet* summarizes the key requirements:

- "Risk Assessments: Sea level rise risk assessments are required when planning shoreline areas or designing larger shoreline projects. If sea level rise and storms that are expected to occur during the life of the project would result in public safety risks, the project must be designed to cope with flood levels expected by mid-century. If it is likely that the project will remain in place longer than mid-century, the applicant must have a plan to address the flood risks expected at the end of the century.
 - Risk assessments are NOT required for repairs of existing facilities, interim projects, small projects that do not increase risks to public safety, and infill projects within existing urbanized areas.
 - o Risk assessments are ONLY required within BCDC's jurisdiction.
 - Risk assessments for projects located only in the shoreline band, an area within 100 feet of the shoreline, need only address risks to public access.
- > Sea Level Rise Projections: Risk assessments must be based on the best estimates of future sea level rise. The California Climate Action Team's sea level rise projections, ranging from 10-17 inches at mid-century and 31-69 inches at the end of the century, currently provide the best available sea level rise projections for the West Coast. However, scientific uncertainty remains regarding the pace and amount of future sea level rise, and project applicants may use other sea level rise projections if they provide an explanation.



- Protecting Existing and Planned Development: Fill may be placed in the Bay to protect existing and planned development from flooding as well as erosion. New projects on fill that are likely to be affected by future sea level rise and storm activity during the life of the project must:
 - Be set back far enough from the shoreline to avoid flooding;
 - Be elevated above expected flood levels;
 - o Be designed to tolerate flooding; or
 - Employ other means of addressing flood risks.
- > **Designing Shoreline Protection**: Shoreline protection projects, such as levees and seawalls, must be designed to withstand the effects of projected sea level rise and to be integrated with adjacent shoreline protection. Whenever feasible, projects must integrate hard shoreline protection structures with natural features that enhance the Bay ecosystem, e.g., by including marsh or upland vegetation in the design.
- Preserving Public Access: Public access must be designed and maintained to avoid flood damage due to sea level rise and storms. Any public access provided as a condition of development must either remain viable in the event of future sea level rise or flooding, or equivalent access consistent with the project must be provided nearby."

This report is intended to address BCDC's risk assessment requirement policy and protection of existing and planned development as listed above.



2. SEA LEVEL RISE DISCUSSION

This section discusses the scientific approach of significant sea level rise publications; sea level rise projections are discussed in Section 3.3.

Thousands of peer-reviewed publications on the topic of climate change and associated sea level rise have been published in the past 20 years. However, the majority of guidance papers produced by federal, state, and other governmental agencies relies on the following literature:

- Assessments based on General Circulation Models (GCM) that use emission scenarios such as those by the Intergovernmental Panel on Climate Change (IPCC 2001, 2007, 2013)
- Assessments based on Semi-empirical models (Rahmstorf, 2007, Vermeer & Rahmstorf, 2009)
- Illustrative Assessments (National Research Council (NRC 1987, USACE 2009)
- Assessments based on a combination of GCMs and Semi-empirical models such as those by the NRC (2012) and the California Climate Change Center (CCCC 2006)

Of note, the reports by the IPCC contain exceptionally detailed syntheses of the available peer-reviewed science of climate change and sea level modeling, and have received contributions and comment from a vast array of respected researchers in the field. The range of sea level rise projections was 4 to 35 inches by 2100 for the 2001 assessment, and 7 to 30 inches by 2100 for the 2007 assessment. Many scientists regarded the IPCC third and fourth assessments (IPCC 2001, 2007) to be scientifically conservative in that less-understood mechanisms such as ice melt, which could also contribute to sea level rise, were not considered in the sea level rise projections because of a lack of broad scientific consensus or understanding of these processes. In particular, the projections did not include potentially large and nonlinear effects such as instability and accelerated loss of the Antarctic and Greenland lce Sheets because no broadly accepted models of these processes exist. In fact the 2007 IPCC document admits that the predictions may be either over or under estimated, at either end of the projected range. High-resolution global altimetry data, through the end of 2009, suggest that in the last two decades, global mean sea level has increased at a rate closer to the upper end of the IPCC 2007 projections.

The fifth assessment (IPCC 2013) uses a new set of emissions scenarios, the Representative Concentration Pathways (RCP) for climate model simulations. The RCPs are mitigation scenarios which explore the effects of 21st century climate policies and thus differ from the noclimate policy scenarios used in previous assessment reports. The report also acknowledges that more comprehensive and improved observations have strengthened the evidence that the ice sheets are losing mass, glaciers are shrinking globally, sea ice cover is reducing in the Arctic, snow cover is decreasing and permafrost is thawing in the Northern Hemisphere. The report projects sea level rise over the next 100 years to be in the range of 11 inches to 38 inches.

The 1987 report by the NRC focuses on the anticipated effects of sea level rise and the recommended responses. It does not make specific projections of sea level rise: rather, it adopts three plausible conditions of 20, 39, and 59 inches by 2100 (0.5, 1, and 1.5 meters). The most recent USACE guidance (Engineering Circular EC 1165-2-211, dated July 1 2009) uses the NRC curves as projections for global sea level rise. The 2012 NRC report on the other hand uses a combination of data from emission models and recent observations of rates of loss of ice to estimate sea level rise ranges. For the California coast south of Cape



Mendocino, the committee projected that sea level will rise 5 to 24 inches by 2050, and 17 to 66 inches by 2100.

Semi-empirical assessments to project sea level rise avoid the difficulty of estimating individual contributions to sea-level rise by postulating that sea level rises faster as the Earth gets warmer. This approach reproduces the sea-level rise observed in the past, but reaching the highest projections would require acceleration of glaciological processes to levels not previously observed or understood as realistic (NRC 2012). The Rahmstorf 2007 assessment estimated 20 to 55 inches by 2100, and the 2009 update estimated 32 to 71 inches by 2100.

The San Francisco Bay Conservation & Development Agency (BCDC) in its guidance policy (BCDC 2011) recommended analysis of a sea level rise allowance of 16 inches by 2050 and 55 inches by 2100 be used by applicants for bayfront development. A summary of various sea level rise projections, which also includes the BCDC estimates, is shown on Figure 2-1.

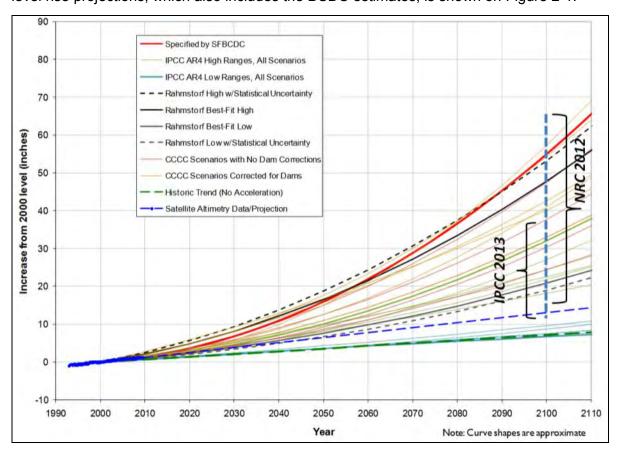


Figure 2-1. Summary of Various Sea Level Rise Projections

An update of the literature was summarized in The Copenhagen Diagnosis, 2009: Updating the World on the Latest Climate Science, which reviewed recent research related to climate change. The independent group of authors point out the uncertainties in developing sea level rise estimates and summarize several peer-reviewed articles. A few quotes from the report specific to sea level rise are reproduced below:

"Future sea level rise is highly uncertain, as the mismatch between observed and modeled sea level already suggests."



"Based on a number of new studies, the synthesis document of the 2009 Copenhagen Climate Congress (Richardson et al. 2009) concluded that updated estimates of the future global mean sea level rise are about double the IPCC Projections from 2007."

"Although it is unlikely that total sea level rise by 2100 will be as high as 2 meters (Pfeffer et al. 2008), the probable upper limit of a contribution from the ice sheets remains uncertain."

Houston and Dean in another very recent study (Houston and Dean 2010) evaluated long term U.S. tide gauge records for the 20th century. Their analyses do not indicate any acceleration in sea level over the last century. Instead, for each time period they considered, the records show small decelerations that are consistent with a number of earlier studies of worldwidegauge records.



3. VULNERABILITY ASSESSMENT

The Treasure Island Development Authority (TIDA) of San Francisco and Treasure Island Community Development (TICD) are working together in a public-private partnership to redevelop the island. Development plans for Treasure Island include 8,000 new homes, up to 500 hotel rooms, a 400-slip marina, restaurants, retail and entertainment venues, and nearly 300 acres of parks and open space as shown on Figure 3-1.



Figure 3-1. Proposed Development Plan for Treasure Island

Projected to be one of the most environmentally-sustainable large development projects in U.S. history, the project was selected as one of 16 founding projects of the Clinton Climate Initiative's Climate Positive Development Program. Treasure Island's location in the Bay and typical low-lying terrain makes the proposed development a perfect example of the need to plan for sea level rise.

3.1 ASSESSING VULNERABILITY TO COASTAL FLOODING

The island was constructed using sand mined from San Francisco Bay in ca. 1936 for the Golden Gate International Exposition. The sandy fill layer is susceptible to liquefaction, and the underlying compressible bay mud layer is subject to settlement over time, which makes it challenging to build tall levees along the perimeter. Given the comparatively higher elevations of land along the south west portion of the island, the decision was made to raise the development footprint rather than rely on flood control levees along the perimeter. Several segments of shoreline areas are presently overtopped by waves and are within the 100-year floodplain, as mapped by FEMA. It was recognized that development within the flood prone parcels would require a detailed statistical analysis of tides, waves, and tsunamis, and construction of appropriate mitigations.

In 2009 M&N conducted a coastal flooding study (M&N 2009a). Coastal flooding in the area is due to varying water levels resulting from a combination of astronomical tides, storm surge, waves on the island shoreline, and tsunamis. Unlike rivers, where guidance on minimum crest



elevation of riverfront areas is provided by FEMA and/or the Army Corps of Engineers due to a high degree of confidence on water levels, coastal areas need to be analyzed on a site-specific basis because water levels in coastal areas are influenced by several factors, each of which varies statistically. FEMA's recommended procedure to establish the Base Flood Elevation is to conduct a Probabilistic Analysis of these factors, based on a combination of coincident events that results in a 1% annual chance of flooding. Additional factors that need to be considered include sea level rise, settlement, structure or project design life, and planned uses within the area to be protected.

The detailed coastal flooding analysis from 2009 was supplemented in 2014 with an additional tsunami and sea level rise update study ("Coastal Flooding Analysis and Adapting to Sea Level Rise- DRAFT"), which evaluated factors that have a high level of variability such as tsunamis, and the various global warming scenarios described earlier (M&N 2009b).

The coastal flooding, tsunami and sea level rise update studies resulted in an identification of the deficiencies in, or vulnerability of, the existing (pre-project) perimeter system. As presented in the *Coastal Flooding Analysis and Adapting to Sea Level Rise – DRAFT* report, Table 3-1 summarizes the existing elevation and updated recommended crest elevation of shoreline reaches along Treasure Island (M&N 2009b). The majority of the existing elevations (current elevations prior to initial construction) lie below the 16" sea level rise updated recommended crest elevations, and therefore those areas represent a public safety risk and possible damages that the Project cannot tolerate, therefore the design incorporates initial construction of the shoreline protection system up to the 16" sea level rise recommended crest elevation (as described in Section 4). The next two sections discuss in detail the sea level rise assessment and project-specific sea level rise projections that were incorporated into the recommended crest elevations.

Existing Updated Recommended Crest Elevation Location Elevations¹ (feet, NAVD 88) (pre-project) 16" SLR3 (feet, NAVD88) 36" SLR 55" SLR 15.1 Southwest 10 to 13 16.5 14.3 West 10 to 11 14.6 15.4 16.8 11 to 13 15.1 16.4 17.8 Northwest North 12 16.8 17.7 19.2 Northeast 10 to 11 13.3 14.8 16.0 11 to 13 11.6 12.6 14.1 East South 11 to 13 10.5 12.2 13.8

Table 3-1. Recommended Perimeter Crest Elevations

Notes:

Source: Coastal Flooding Analysis and Adapting to Sea Level Rise – DRAFT, Moffatt & Nichol (M&N 2009b).

Figure 3-2 shows the specific reaches where the different perimeter berm elevations apply.

¹ Assumes a compound shoreward slope of 2H:1V below +12 feet NAVD 88, and a 3H:1V slope above +12 feet NAVD 88.



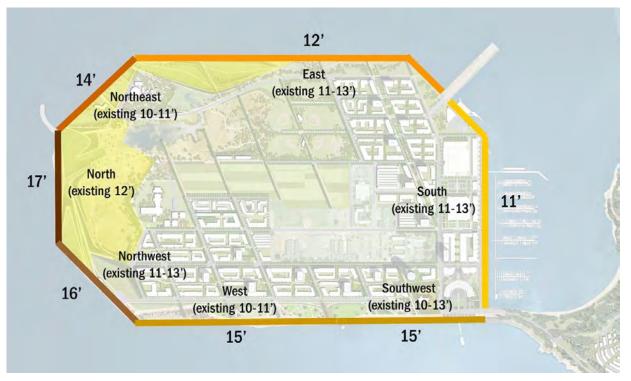


Figure 3-2. Reaches Applicable to Specified Berm Crest Elevations

Identification of the above perimeter vulnerability allowed project planners to evaluate the consequences of different levels of improvements along the perimeter, as well as different site grades. In the case of Treasure Island, the areas that cannot tolerate flooding (low adaptive capacity such as urban promenades, building pads, City parks) will be raised, whereas passive use open space areas where infrequent flooding can be tolerated (high adaptive capacity) will not be raised as much.

3.2 ASSESSING SEA LEVEL RISE

Sea level rise was not included in the probabilistic analysis because it is not an episodic phenomenon; in fact it has a high probability (virtually certain) of occurrence but the variable is the rate at which it will occur. In developing the estimates of future flood elevations for the project, it was necessary to select a set of sea level rise projections based on the literature. However, given the wide spread in sea level rise projections in the scientific documents, and to accommodate to emerging development of guidance from agencies, a risk-based approach was used to estimate the sea level rise allowance that's added on to the proposed grades from the preceding coastal flooding analysis.

The CO-CAT report (2013) has a good discussion on risks and consequences related to coastal flooding and sea level rise, and identifies a practical decision-making process. Although the report was not published at the time of this analysis, the analysis conducted for the Treasure Island study was almost identical, therefore the discussion and related graphics from the report are presented below.

Risk is usually evaluated by comparing the probability that impacts would occur (or likelihood), to the consequence of these impacts. Criteria such as the extent, scale and magnitude of the impact, combined with the adaptive capacity of an asset, define the consequence (see Figure 3-3).



	Low	Medium	High
	Adaptive	Adaptive	Adaptive
	Capacity	Capacity	Capacity
High	HIGH	HIGH	MEDIUM
Impact	CONSEQUENCES	CONSEQUENCES	CONSEQUENCES
Medium	HIGH	MEDIUM	LOW
Impact	CONSEQUENCES	CONSEQUENCES	CONSEQUENCES
Low	MEDIUM	LOW	LOW
Impact	CONSEQUENCES	CONSEQUENCES	CONSEQUENCES

This figure demonstrates how the consequences of a decision are determined by the amount of impact and by the adaptive capacity. There are higher consequences when there are greater impacts and lower adaptive capacities.

Figure 3-3. Evaluating Consequences Based on Flooding Potential and Site Elevations

Several documents (CO-CAT 2013, IPCC 2007, NRC 2012) have also defined risk as the product of the likelihood of damage and the consequence of damage, which can be expressed as:

Risk = Likelihood × Consequence

To evaluate risk to an asset, both likelihood and consequence need to be characterized. An asset could be a commercial, residential, or recreational property, an infrastructure facility, public health and safety, and/or the environment. The likelihood factor in the above expression can be described by the scientific studies that have estimated projections of sea level rise, both globally as well as for San Francisco Bay.

The consequence of failing to address sea level rise for a particular project will depend on both the Vulnerability of the asset to sea level rise and the Adaptive Capacity of the asset, which is a measure of the ability of a system to cope with consequences of climate change. For example, an asset which is highly vulnerable to sea level rise and also has a low adaptive capacity will have a high consequence of failing. An asset that has high adaptive capacity and/or low potential impacts will experience fewer consequences. This is summarized in Figure 3-4. Based on the above, a typical Risk Assessment should therefore consist of the following tasks:

- Assess Vulnerability
- Determine Adaptive Capacity and Risk Tolerance
- Estimate Value of Asset Over its Expected Life (tangible as well as intangible)
- Develop Adaptation Strategy



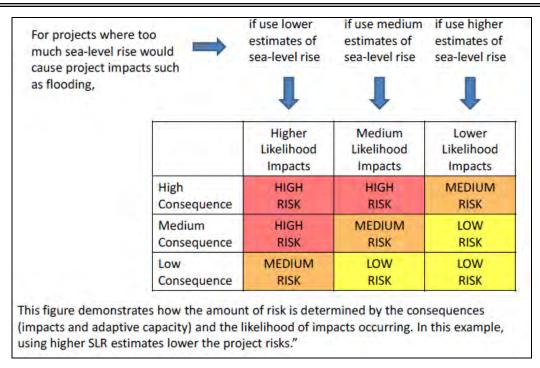


Figure 3-4. Evaluating Risk Based on Likelihood and Consequences

3.3 PROJECT SPECIFIC SEA LEVEL RISE PROJECTIONS

For the Treasure Island project, two criteria were used in the sea level rise analysis to evaluate the likelihood and the range of projections.

First, it was important to distinguish between scientific projections (such as those based on modeling of emissions and/or semi-empirical models) and illustrative cases such as those in the NRC 1987.

Second, the science of climate change and sea level rise is evolving and improving, even if it does not lead to a narrower spread of projections over time. For example, ice sheet dynamics is a very active research field, and measurements of the polar ice caps are showing rapid melt in some areas. Therefore, more recent projections should be given more consideration than those made earlier.

The study therefore focused on the reports authored by the IPCC, the NRC, and Rahmstorf. The different projections of sea level rise between 1990 and 2100 summarized earlier (see Figure 2-1) shows the spread of data, especially after 2050. All projections start at zero in 1990. This is also a convenient start date for investigating the effects of sea level rise on the base flood elevation, because the Mean Lower Low Water datum – used in the estimation of coastal flooding – is based on the 1983-2001 tidal epoch. 1990 is close to the midpoint of this tidal epoch, therefore it is not necessary to "normalize" the projections by setting the increase in sea level to the present day (2009) or the projected construction date.

In discussions with project planners related to the planning horizon for the development, the desire was to have a low risk of sea level rise related impacts over at least a 70-year duration. A typical financing mechanism (loans and/or bonds) takes about 30 years to service the debt; a 70-year duration would allow a minimum of two such debt mechanisms after the planning/construction phase of about 10 years. This was also perceived to be about the length of time at which significant infrastructure improvements are made to communities. Over this



period, even with the most aggressive projection of sea level rise, the increase in sea level reaches 36 inches between 2075 and 2080 (see Figure 3-5). In fact for many of the projections shown in Figure 2-1, the 36-inch increase is not reached until after 2100.

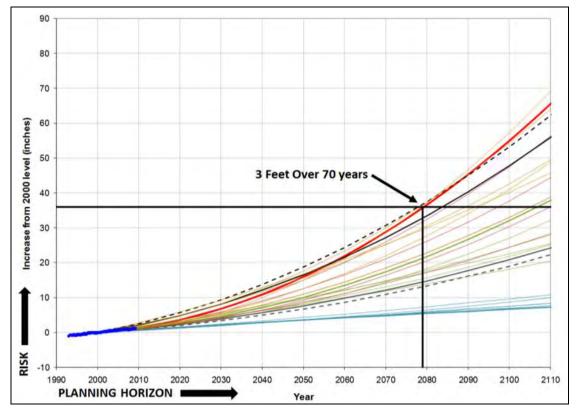


Figure 3-5. Sea Level Rise Projection Used For the Treasure Island Project

In March 2013, the Sea-Level Rise Task Force of the CO-CAT released their State of California Sea-Level Rise Guidance Document based on the recently published (June 2012) NRC Sea-Level Rise for the Coasts of California, Oregon, and Washington. Table 3-2 summarizes the sea level rise projections, including the low and high range values, for the San Francisco Bay area. Further, the CO-CAT guidance recommends that sea level rise values for planning be selected based on risk tolerance and adaptive capacity.

Table 3-2. Sea Level Rise Projections for San Francisco, California (NRC 2012 Report)

Time Period	Low	Projected	High
2000-2050	4.5"	11.0"	23.8"
2000-2070*	8.4"	18.5"	38.5"
2000-2100	16.5"	36.0"	66.0"

Interpolated based on City & County of San Francisco's Sea Level Rise Guidance document (City & County of SF Sea Level Rise Committee 2014).

BCDC has recently approved two projects [Burlingame Point Development (Burlingame) and Blu Harbor Development (Redwood City)] within the San Francisco Bay area based on the projected values for the 2050 and 2100 timeframes shown above.



Based on the values in Table 3-2, the Project adopted the following:

- 36" of sea level rise allowance for development features with low adaptive capacity (building pads and major streets). This would ensure that these assets are protected well into the future (2070 to beyond 2100 depending on observed sea level rise rates) regardless of the condition of the shoreline.
- A similar level of protection for the Project's perimeter (36" of sea level rise), except that the construction would be implemented in two phases:
 - 16" of sea level rise allowance at the end of initial Project construction which would ensure that no additional work is needed until about 2050 or most likely beyond 2050, and,
 - An additional 20" of sea level rise allowance when observed sea level rise rates approach the 16" threshold. This is because the development features (parks and open space) envisioned along the perimeter have a high adaptive capacity and high resilience.
- An adaptive management plan including a dedicated funding mechanism for sea level rise adaptations when sea level rise exceeds the allowances described above (see Section 6 for funding mechanism description).

A sea level rise of 16 inches was adopted for the Project as a conservative sea level rise projection for mid-century. Because this Project will remain in place longer than mid-century, end of century sea level rise projections of 36 inches were also incorporated.



4. PROJECT DESIGN FEATURES

Based on the above review and quantitative estimates of sea level rise for San Francisco Bay, and numerous discussions with TIDA, TIDC, and other City agencies, a strategy for protection against sea level rise was adopted for the project customized to the adaptive capacity of different elements. Since building structures are generally "immovable" (i.e. high consequences), whereas a shoreline protection system and/or storm drain system can be adapted to keep up with changing sea levels (i.e. low consequences), different planning horizons were adopted for the different elements. In general, the sea level rise strategy was built around the following key elements, which are also summarized in Figure 4-1:

- 1. Raise grades for the new development to accommodate sea level rise over a 70-year horizon.
- 2. Improve the perimeter protection and interior drainage up to mid-century levels at a minimum to prevent obstruction of view corridors and ponding, while providing protection against coastal flooding.
- 3. Develop an Adaptation Strategy for improvements beyond mid-century levels (as described in bullet 2 above) to the shoreline protection system and drainage system in the event that actual sea level rise exceeds certain thresholds.
- 4. Include development setbacks to allow sea level rise projection improvements along the perimeter.
- 5. Identify a stream of funding to construct these improvements as part of the Adaptation Strategy.



Figure 4-1. Sea Level Rise Strategy



Specific design features are described below.

Development Areas

Since building pads and finished floors are not adaptable, all buildings and entrances to subterranean parking and streets would be set at an elevation that is 36-inches higher than the present day 100-yr return period water level in the Bay. This 36-inch sea level rise allowance plus a freeboard of 6 inches (42 inches total) would be used for finished floor elevations of all buildings. This would ensure that even if no shoreline protection improvements are undertaken, or in the event of a slope failure along the shoreline, buildings and transportation infrastructure would not be flooded for water levels 42 inches higher than current BFE. This exceeds the elevations in the 2080 time frame according to the most aggressive sea level rise, and well beyond 2100 according to the highest IPCC projection.

Shoreline Protection System

It is not practical to build a high wall around the project for a design condition that may not happen for several decades, because it would pose a visual obstruction and severely limit public access. At the same time, it is not practical to build to present sea level conditions and keep raising it as sea levels rise. Therefore, at initial construction the perimeter elevation will be raised to prevent coastal flooding associated with the 1% annual chance storm event for present day conditions, as well as an additional allowance for 16-inches of sea level rise.

Future sea level rise related improvements would be accommodated at the shoreline to allow elevation increases in the future. Future elevation increases along the perimeter would be at least 3 feet, with the ability to go even higher (up to and higher than the 55-inch estimate recommended by the CALFED committee) with either the same or a different structural configuration. This will ensure that the project will not be mapped as a FEMA flood zone either now or in the future when sea level rise could approach 3 feet.

Storm Drain System

The storm drain system will be constructed such that it can gravity-drain, even with a sea level rise of 16-inches, and will be adaptable to higher levels of sea level rise with minimal intervention. It will thus function as a gravity-drained system until such time that sea level rise reaches 16-inches, beyond which the Adaptation Strategy will be implemented consisting of installing storm drain pumps.

Adaptation Strategy

When sea level rise approaches or exceeds the level of protection that the shoreline perimeter is designed for, adaptation will be needed. Specifics of the adaption strategy are described in next section.



5. ADAPTIVE MANAGEMENT PLAN

The adaptive management plan for Treasure Island includes the following:

- 1. TIDA responsibilities
 - a. TIDA will manage the adaptive strategy for Treasure Island. Once sea level rise is foreseen to exceed the level of shoreline perimeter protection, TIDA will begin to provide guidance, identify relevant stakeholders, define appropriate management actions and triggers, and establish a long-term, project-specific funding mechanism.
 - b. TIDA will develop, implement, and update a monitoring program for TI. The monitoring program will include observing sea level rise measurements and perimeter elevations (to quantify settlement).
- 2. Monitoring Program: sea level rise measurements and perimeter elevations
 - a. TIDA will monitor sea level rise using scientific guidance and updates from a variety of federal agencies (including NOAA, USGS, and others), regional agencies (such as the USACE, BCDC and others), and state and federal guidance documents (such as CO-CAT and NRC reports).
 - b. TIDA will monitor ongoing settlement by conducting periodic topographic surveys (cross sections).
 - c. TIDA will incorporate the sea level rise measurements and topographic survey results into updated flooding assessments and the adaptive management plan (if necessary) that would guide the decision making process for future improvements.
- 3. Trigger mechanisms and actions (see Figure 5-1)
 - a. When a sea level rise of about 12 to 13 inches has occurred (compared to 2016 sea levels), planning would be initiated to raise Treasure Island's perimeter crest and install necessary storm drain system improvements. These improvements would be constructed before a sea level rise of 16 inches (compared to 2016) has occurred. The improvements would mitigate more frequent wave overtopping and storm drain backups, and would include allowances for future sea level rise as projected at that time. The improvements would accommodate a sea level rise of about 36 inches (compared to 2016).
 - b. When a sea level rise of about 32 inches (compared to 2016) has occurred, planning would be initiated to improve the shoreline protection system to act as a flood barrier (levee or floodwall). These improvements would be constructed before a sea level rise of 36 inches (compared to 2016) has occurred. The improvements would provide for future sea level rise as projected at that time (e.g. 55 inches or larger).

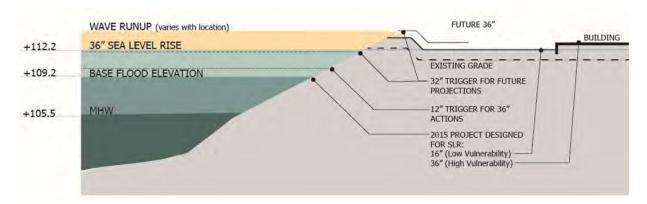


Figure 5-1. Sea Level Rise Triggers

4. Implementation

- a. The elevation and structural characteristics of the island's perimeter are key components of Treasure Island's Adaptation Strategy. The proposed development setback distances will enable a variety of future modifications along the shoreline protection system to accommodate the projected future values of sea level rise, with the ability to accommodate even higher values of sea level rise if necessary (e.g. in the unlikely event that greater than 66 inches is realized). All strategies would factor in the importance of public safety. Shoreline modifications would likely include a combination of the following strategies depending on desired open space uses and wave runup characteristics at different locations around the island:
 - i. Raising the shoreline embankment in place to function as a storm surge or flood barrier, including a levee;
 - Constructing a series of embankments of increasing heights away from the water. Land between sets of embankments can hold periodic wave overtopping that drain out between high tides while creating habitat;
 - iii. Constructing sea walls particularly at the proposed ferry quay and along the marina promenade, where they would also function as a public amenity;
 - iv. Laying back the shoreline to create cobblestone beaches to limit wave runup and overtopping, creating accessible public amenities.
- b. Some representative examples of future adaptations are presented in Figure 5-2, Figure 5-3, Figure 5-4 and Figure 5-5.



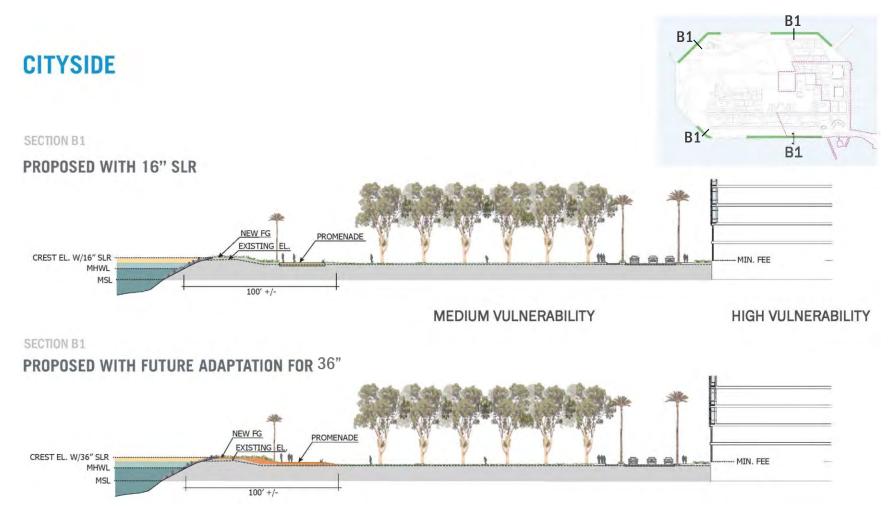


Figure 5-2. Cityside Adaptation Strategies



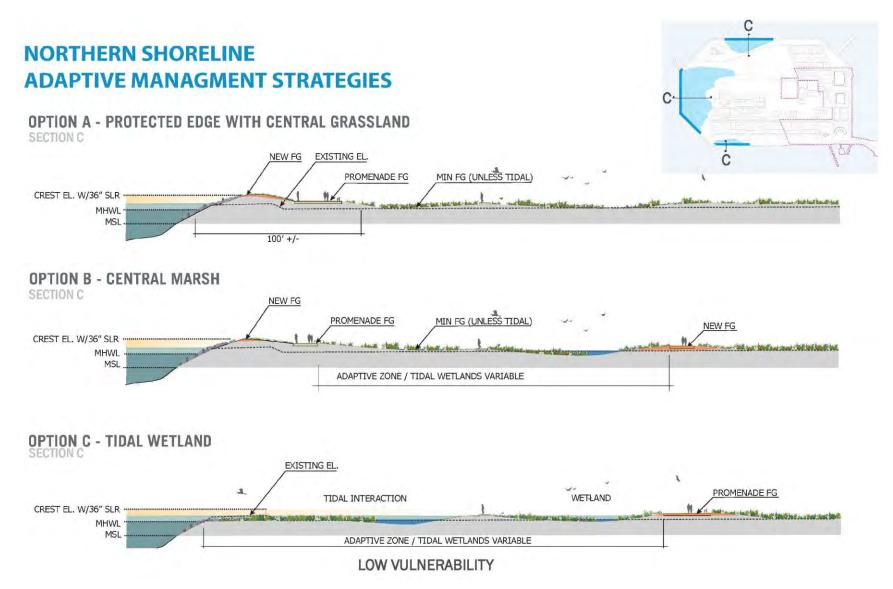
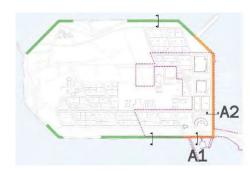


Figure 5-3. Northern Shoreline Adaptation Strategies







SECTION A1 FERRY TERMINAL



SECTION A2 CLIPPER COVE PROMENADE



Figure 5-4. Southern & Southwestern Shoreline Adaptation Strategies

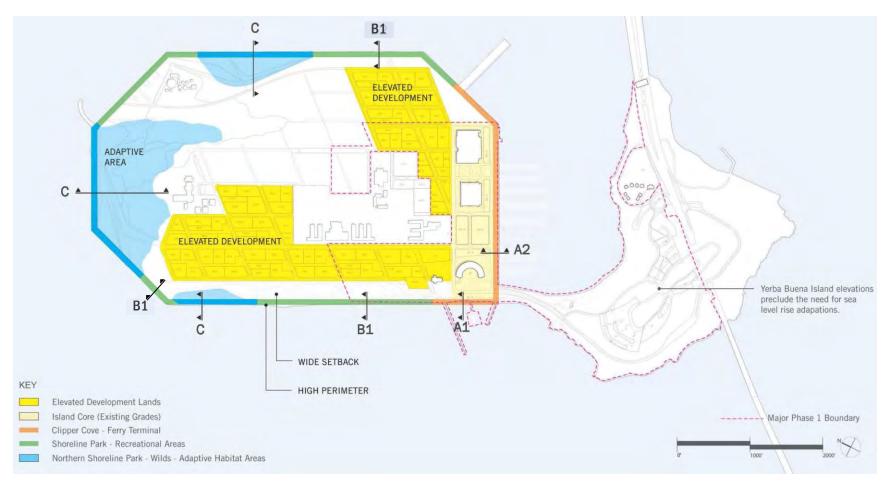


Figure 5-5. Sea Level Rise Adaptation Strategies



6. ADAPTIVE MANAGEMENT PLAN FUNDING

The Disposition and Development Agreement for the project between TIDA and TICD, as well as the Development Agreement between the City and County of San Francisco and TICD, include a Financing Plan with a mechanism for funding the adaptive management strategies and improvements described in Section 5. The Financing Plan directs that Special Taxes* collected via the establishment of Community Facilities Districts (CFD) on Treasure Island and Yerba Buena Island can be used to pay for future Sea Level Rise Improvements. More specifically, if the appropriate regulating authorities require the construction or installation of improvements to ensure that the shoreline, public facilities, and public access will be protected should sea level rise at the perimeter of the islands, TIDA, the City and TICD agree to finance the improvements with such project-generated CFD Bonds.

*Special Taxes are supplemental property taxes collected in the same manner as general property taxes.



7. REFERENCES

California Climate Change Center (2006). Projecting Future Sea Level. California Climate Change Center report number CEC-500-2005-202-SF. Cayan, D., P. Bromirksi, K. Hayhoe, M. Tyree, M. Dettinger, and R. Flick, March 2006

California Natural Resources Agency (2009). 2009 California Climate Adaptation Strategy, A Report to The Governor of the State of California in response to Executive Order S-13-2008.

City and County of San Francisco Sea Level Rise Committee. 2014. Guidance for Incorporating Sea Level Rise Into Capital Planning in San Francisco – Assessing Vulnerability and Risk to Support Adaptation. September 2014.

Coastal and Ocean Working Group of the California Climate Action Team (CO-CAT 2013). State Of California Sea-Level Rise Guidance Document, March 2013 update

Houston J. and R. Dean (2010). Sea-Level Acceleration Based on U.S. Tide Gauges and Extensions of Previous Global-Gauge Analyses. Journal of Coastal Research. DOI: 10.2112/JCOASTRES-D-10-00157.1.

Intergovernmental Panel on Climate Change (2001). Climate Change 2001: The Scientific Basis. Contribution of Working Group I to the Third Assessment Report of the Intergovernmental Panel on Climate Change. Houghton, J.T., Y. Ding, D.J. Griggs, M. Noguer, P. J. van der Linden and D. Xiaosu (eds.).

Intergovernmental Panel on Climate Change (2007). Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Solomon S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M. Tignor, and H.L. Miller (eds.).

Intergovernmental Panel on Climate Change (2013). Climate Change 2013: The Physical Science Basis. Working Group I Contribution to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Stocker T, D. Qin, G. Plattner, M. Tignor, S. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex, P. Midgley (eds.).

Moffatt & Nichol (2009a). Treasure Island Development Project Coastal Flooding Study, Prepared for Treasure Island Community Development. April 2009.

Moffatt & Nichol (2009b). Treasure Island Ferry Terminal Project, Coastal Engineering Assessment. Prepared for Water Emergency Transportation Authority. September 2009.

Moffatt & Nichol (2014). Coastal Flooding Analysis & Adapting to Sea Level Rise. Prepared for Treasure Island Community Development. October 2014.

National Research Council (2012). Sea-Level Rise for the Coasts of California, Oregon, and Washington: Past, Present, and Future. Committee on Sea Level Rise in California, Oregon, and Washington. Board on Earth Sciences and Resources and Ocean Studies Board, Division on Earth and Life Studies. The National Academies Press, Washington, D.C., 2012

National Research Council (1987). Responding to Changes in Sea Level: Engineering Implications. National Academy Press.

Rahmstorf, S. (2007). A Semi-Empirical Approach to Projecting Future Sea-Level Rise. Science Magazine 315, pp. 368-370.

San Francisco Bay Conservation and Development Commission (2011). Living with a Rising Bay. Vulnerability and Adaptation in San Francisco Bay and on its Shoreline. October 2011.



U.S. Army Corps of Engineers (2009). Incorporating Sea-Level Change Considerations in Civil Works Programs. Engineering Circular EC 1165-2-211. July 2009.

Vermeer, M. and S. Rahmstorf (2009). Global sea level linked to global temperature. Proceedings of the National Academy of Science of the USA, 106, 21527-21532.